ONE-PIECE IMPLANTATION LENS

BACKGROUND OF THE INVENTION

This invention refers to a one-piece implantation lens as a replacement for a natural lens which has been surgically, particularly extracapsularly, removed from the eye of living beings of a higher order and which has, on the one hand, a central lens body designed as a collective lens and, on the other hand, holding means in the form of thin-walled, flat support elements arranged peripherally on the lens body, radially extending outwardly from the lens body and fixing it in place, with the outer edge of the support elements lying on a circular arc around the center of the lens body; and which consists of a homogenous, crystal-clear, high-temperature resistant plastic, preferably vulcanized siliconematerial, with a specific gravity of between 1.01 and 1.08, preferably approximately 1.02.

Implantation lenses of the type described above have already proven their excellence in practical ophthalmology.

The wish has been expressed to be able to fold the lenses of the type in question, which consist of a flexible material, in order to enable them to be inserted into the eye through as small an incision as possible, of only a few millimeters in length, after the natural, clouded lens has been extracapsularly removed. On the one hand, it is necessary that the material of the implantation lens be relatively soft and flexible, but stiff enough to guarantee stability of form of the lens, yet on the other hand, the lens should be foldable for the reasons given above. However, the foldability of lenses with a corresponding thickness of the central lens body is limited in view of the required refracting power.

SUMMARY OF THE INVENTION

In order to do justice to all requirements set, the suggestion for the solution of the problems is to design the implantation lens in question such that at least one of the two surfaces of the central lens body is designed in the manner of the optically effective surface of a Fresnel lens, i.e. the lens is compiled of individual peri-axial ring zones with steps provided between them. The radii of curvature of the individual zone areas are selected such that the focal points of all zones coincide. It is thereby possible to provide a lens with relatively thin walls, to substantially reduce its volume and to achieve an appreciable reduction in weight. But in particular, lenses with this design can be more easily folded to reduce their width in the folded state to approximately one-half of the original width.

BRIEF DESCRIPTION OF THE DRAWINGS

Further features of the implantation lenses according to the invention can be found in the subclaims and the following description of a number of preferred embodiments, which are shown in FIGS. **1** to **12** of the drawings.

FIGS. **1** to **8** each show a cross section through one of various embodiments of the implantation lens according to the invention;

FIGS. **9** to **12** show plan views of implantation lenses according to FIGS. **1** to **8** with different outlines.

DETAILED DESCRIPTION OF THE DRAWINGS

The implantation lens according to FIG. **1** consists of a flat plate of crystal-clear, flexible material, with a central lens body **11** arranged in the center thereof; the front of this lens body consists of the stepped ring zones **12** of a Fresnel lens **13**. The rear of the lens body **11** is flat, for instance. The lens comprises a single piece. The support elements **14** are arranged on the periphery of the central lens body.

The lens according to FIG. **2** corresponds with that of FIG. **1** but in this figure the rear side of the central lens body **11** is convex. A rounded annular bulge **15** is located on the outer periphery of the support elements **14** to enlarge the contact surface on the sensitive tissue and to reduce the surface pressure.

In the lens according to FIG. **3**, the two surfaces of the central lens body **11** are provided with stepped rings **12**. The lens according to FIG. **4** is curved toward the rear across its entire length. The front surface of the central lens body **11** consists of stepped rings **12** of a Fresnel lens.

The implantation lenses according to FIGS. **5** and **6** show a biconvex central lens body **11**, with a stepped rear surface. In the case of FIG. **5**, the implantation lens is curved and in the case of the embodiment according to FIG. **6** it is straight. In the implantation lens according to FIG. **7** the central lens body **11** consists of a plano-convex lens with a stepped rear convex surface. The support elements **14** are angled toward the front relative to the central lens body **11**. The embodiment of the implantation lens according to FIG. **8** corresponds essentially to that of FIG. **7**. In this case the central biconvex lens body **11** is stepped both in the front and in the rear. The support elements **14** are also provided with an outer peripheral annular bulge **15**.

The use of the embodiments of the implantation lens according to FIGS. **5** to **8** as a posterior chamber lens has the advantage that the posterior capsule still present in the eye can not abut the central rear surface of the implantation lens, as it is held at a desired distance from the lens by the backwardly projecting steps in the lens. The intermediate space thereby formed is important in the event that subsequent cataract formation occurs on the posterior chamber, which can then be broken up by a Yag laser without damaging the implantation lens at the same time.

In FIGS. **9** to **12** embodiments of the implantation lens are shown, wherein the central lens bodies can be provided with steps **12** as shown in FIGS. **1** to **8**.

Implantation lenses in which the lower edge of the lower support element **14** is equipped with an annular bulge **15** and in which the lower edge is wider than the diameter of the central lens body, have the advantage that the contact surface which the tissue abuts is larger than the contact surface on the upper edge, so that the frequently observed rotation of the implantation lens in the eye can be avoided. If applicable, one or two notches **16** can be provided in the lower edge of the annular bulge **15**, in order to counter the tendency of the lens to rotate.

All of the above-described and shown lenses offer the advantage of being extraordinarily light and flat, so that, if desired, they can also be folded to enable them to be inserted through the smallest possible incision in the cornea upon removal of the clouded lens, into the ante-